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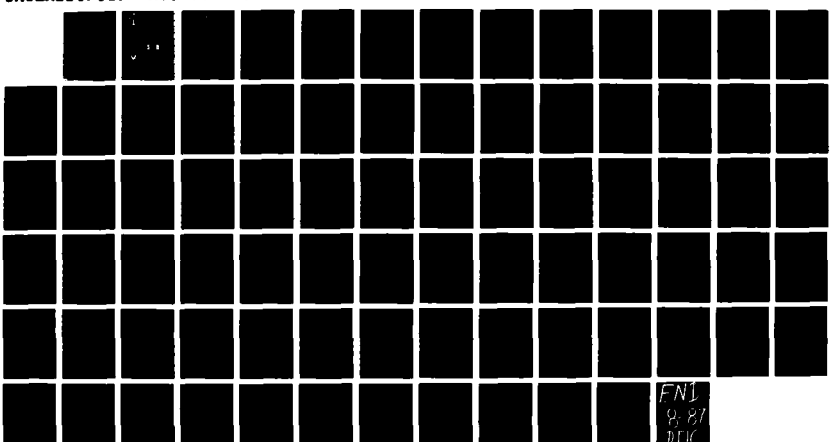

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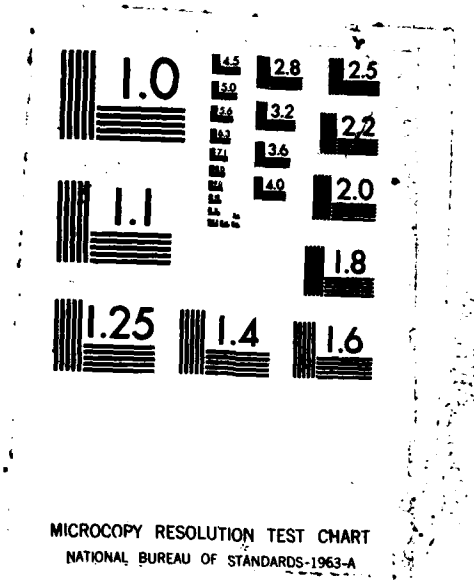
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TECHNICAL REPORT RD-RE-86-9

VERTICAL WINDSHEAR BELOW 5.5 KILOMETERS IN THE VICINITY OF BERLIN, GERMANY

L. Levitt,
O. M. Essenwanger
Research Directorate
Research, Development, and Engineering Center

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AUGUST 1986

U.S. ARMY MISSILE COMMAND
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1a. REPORT SECURITY CLASSIFICATION Unclassified	1b RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S) TR-RD-RE-86-9	5. MONITORING ORGANIZATION REPORT NUMBER(S)
6a. NAME OF PERFORMING ORGANIZATION Research Dir Res, Dev, and Eng Ctr 6b. OFFICE SYMBOL (If applicable) AMSMI-RD-RE	7a NAME OF MONITORING ORGANIZATION
6c. ADDRESS (City, State, and ZIP Code) Commander US Army Missile Command ATTN: AMSMI-RD-RE Redstone Arsenal, AL 35898	7b ADDRESS (City, State, and ZIP Code)
8a. NAME OF FUNDING/SPONSORING ORGANIZATION 8b OFFICE SYMBOL (If applicable)	9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER
8c. ADDRESS (City, State, and ZIP Code)	10 SOURCE OF FUNDING NUMBERS PROGRAM ELEMENT NO / PROJECT NO / TASK NO / WORK UNIT ACCESSION NO

11. TITLE (Include Security Classification)

Vertical Windshear Below 5.5 Kilometers in the Vicinity of Berlin, Germany

12. PERSONAL AUTHOR(S)

L. Levitt and O. M. Essenwanger

13a TYPE OF REPORT	13b TIME COVERED FROM _____ TO _____	14 DATE OF REPORT (Year, Month, Day) 1986 August	15 PAGE COUNT

16. SUPPLEMENTARY NOTATION

17 COSATI CODES			18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB-GROUP	

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

Vertical windshear below 5.5 km is presented in this report based on 1200 GMT observations taken at the Berlin-Templehof Airport. The vector shear calculations take into account both windspeed and wind direction changes, and represent the deviation of the windspeed and direction from one measurement point to another. Frequency distributions of differences in windspeed (scalar shear), differences in wind direction (angular differences), and vector shear were tabulated for various permutations of five pressure levels: surface, 1000mb (near surface), 850mb (1.5 km), 700mb (3 km), and 500mb (5.5 km). The 50, 90, 95, 97.5 and 99 percent values of the scalar shear, angular differences, and vector shear are also included. The results are presented by month and season along with annual means. The magnitude of the windshear in the layer surface to 1.5 km for the selected thresholds are (in sequence) 20.8, 31.4, 38.2, 44.2, and 48.1 knots for January, decreasing to 9.5, 18.7, 22.5, 24.0, and 24.2 knots for July. The smallest windshears were found for the layer surface to 1.5 km.
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20 DISTRIBUTION/AVAILABILITY OF ABSTRACT	21 ABSTRACT SECURITY CLASSIFICATION
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and are (annual averages) 7.5, 15.7, 18.5, 21.6, and 24.9 knots. The largest windshear magnitudes were associated with the surface to 5.5 km layer and are 31.9, 57.0, 59.6, 76.8, and 77.7 knots, decreasing to 17.8, 32.6, 38.4, 44.8, and 49.2 knots in July for the selected thresholds.

ACKNOWLEDGMENT

The authors would like to thank Mr. Helmut P. Dudel and Dr. Dorathy A. Stewart for helpful suggestions. Thanks also go to Ms. Gloria McCrary for her careful typing of the manuscript.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

LIST OF TABLES (Continued)

I. INTRODUCTION

The vertical variation of the horizontal wind has been extensively studied in the boundary layer below 100m. Much less data are available concerning windshear for altitudes above this height in the troposphere. Studies such as Alfuth and Alsobrook [1] provided frequency distributions of vector windshear in 1/2 km intervals from 3 km to as high as 27 km, and Essenwanger [2], [3], derived vector windshears for layers from surface to 2 km and above 8 km for application to missile design. Grossman and Beran [4] analyzed low-level windshear at selected U.S. airports in the layers surface to 150m and 150m to 300m for a 9 year period with particular emphasis on the occurrence of extreme windshears which may affect aircraft takeoff and landing.

The purpose of this report is to provide information of vertical windshear for selected atmospheric layers between surface and approximately 5.5 km for one location, Berlin, Germany. The data that are presented in this report are unique for several reasons. The windshear analysis was performed for specific altitudes that have not been included in other reports (i.e., 2 to 5.5 km).

The windshear calculations presented here also take into account the contribution of wind direction changes ("angular shear magnitude") which constitutes a different approach than in other reports devoted to windshear. Grossman and Beran [4] have calculated "total vector windshear" (length of the horizontal difference vector). Alfuth and Alsobrook [1] calculated the total vector windshear divided by the thickness of the layer and called that simply the "vector windshear." This approach was criticized by Essenwanger [5] who could show that the transformation of the vector windshear from one shear interval to another interval is not a linear function or ratio. Essenwanger [2], [3] utilized a functional relationship between total vector windshear and thickness of the layer which had previously been derived.

It should be noted that Arritt and Frank [6] calculated windshear for some of the same atmospheric layers reported here (boundary layer- 700mb, 850-700mb, 700-500mb). They do not outline their computational procedure, but claim that both speed and direction are taken into account. However, only the results of evaluating these parameters in a multiple regression scheme to predict rainfall amount are discussed, and no windshear statistics are reported.

Ohring et.al. [7] reported the results of deriving vertical windshears from the gradients of satellite radiance observations. A number of limitations with these methods still exist, e.g., trying to determine small horizontal gradients over small distances, uncertainties in transmission functions, and differences between the thermal windshear (as determined by satellite) and actual windshear. Also, these methods were applied to the lower stratosphere to eliminate the deleterious effects of cloud contamination. Therefore, a climatology of windshear as derived by satellite has not yet appeared in the literature.

II. METHODS AND DATA

All observations were taken at the Berlin-Templehof airport at 1200 Greenwhich Mean Time (GMT), and the period of record is 1974-78, and 1981.

The following notations were used:

$V_s = V_2 - V_1$ (scalar shear)

$\Delta\theta = \theta_2 - \theta_1, \quad |\Delta\theta| \leq 180$ degrees (angular difference)

$\Phi_s = 2\sqrt{V_1 V_2} \sin(\Delta\theta/2)$ (angular shear magnitude)

$S = \sqrt{V_s 2 + \Phi_s 2}$ (total vector shear)

where V_1, θ_1, V_2, and θ_2 are windspeed and direction at two different pressure levels, respectively. See Essenwanger [8] for a derivation of the equation for total vector shear. The frequency distributions of the scalar shear, angular differences, and vector shear were tabulated for all but one of the possible permutations of five pressure levels: Surface (10m), 1000mb (near surface), 850mb (1.5 km), 700mb (3 km), and 500mb (5.5 km). The 50, 90, 95, 97.5 and 99 percent values of the scalar shear, angular differences, and vector shear are also included. The permutation of surface and 1000mb was omitted because discussion of the boundary layer is beyond the scope of this report.

III. DATA DISCUSSION

Tables 1-9 display the percent occurrence of the differences in windspeed for the following atmospheric layers (in order of presentation): Surface and 1.5 km, near surface and 1.5 km, surface and 3 km, near surface and 3 km, 1.5 km and 3 km, 3 km and 5.5 km, 1.5 km and 5.5 km, near surface and 5.5 km, and surface and 5.5 km. For the layer between surface and 1.5 km (Table 1), windspeed differences of greater than 5 knots occurred with a frequency of 85.3 percent, decreasing to 65.5 percent in summer. The percent occurrence of windspeed differences greater than or equal to 15 knots occurred with a frequency of 49.5 percent in winter, decreasing to 12 percent in summer. For the layer between surface and 3 km (Table 3), windspeed differences of less than or equal to 5 knots and greater than or equal to 15 knots occurred with a frequency of 10.9 percent and 56.1 percent respectively in winter, compared to 27.7 percent and 26.2 percent in summer. These statistics are reflective of the anticipated increase of windspeed with height for the particular layers of interest. The largest windspeed differences occurred when considering the thickest atmospheric layer of surface to 5.5 km (Table 9), e.g., windspeed differences of greater than 11 knots occurred with a frequency of 82.8 percent in winter and 58.5 percent in summer. The percent occurrence of windspeeds greater than or equal to 15 knots for this layer was 77.5 percent in summer, decreasing to 46.5 percent in summer.

Variation of wind direction with height is another important factor in the boundary-layer; the surface wind will tend to blow across the isobars toward lower pressure. Warm advection tends to increase frictional wind veering, while cold advection has the opposite effect. However, in the free atmosphere (where surface friction no longer plays a role), the wind approaches the gradient wind, i.e., it blows approximately parallel to the isobars.

Tables 10 through 18 disclose the percent occurrence of the differences in wind direction for the same sequence of atmospheric layers as indicated above. Note that wind directions are reported to the nearest 5 degrees. For the layer surface to 1.5 km, windspeed differences of less than 30 degrees and 30 to 55 degrees occurred with a frequency of 36.1 percent and 38.3 percent respectively in winter, compared to 55.7 percent and 27.7 percent in summer (Table 10). Evaluating the layer from just above the surface (1000mb pressure level) to 1.5 km, wind direction differences are somewhat smaller due to the decreasing effect of friction. (Similar results are noted for other layers when 1000mb is substituted for the surface). The highest percentage of 60 to 85 degree wind direction differences were noted for the surface to 3 km layer (Table 12) and surface to 5 km layer (Table 18), which is approximately 20 percent for both of these layers. Wind direction differences of less than 30 degrees between 1.5 km and 3 km occurred with a frequency of 77.2 percent in winter and 78.7 percent in summer, which is the highest percentage for any of the layers that were considered here (Table 15).

We learn from Tables 19 through 27 the percent occurrence of windshear for each of the atmospheric layers. A windshear of less than 5 knots occurred with a frequency of 7 percent in winter and 21.6 percent in summer for the layer surface to 1.5 km. Considering all observations, the percent occurrence of windshear greater than or equal to 30 knots (not shown in Table 19) between surface and 1.5 km at Berlin is 5 percent. A windshear of 24 knots between surface and 1.5 km is exceeded in 4 percent of the cases in summer and 30 percent in winter. For the layer between surface and 3 km, a windshear of less than 30 knots occurs 96.5 percent of the time in summer in contrast to 75.5 percent during winter, which is a reflection of the increase in differences in windspeed and direction during fall and winter. It should be noted that a windshear of less than 15 knots for this layer occurs with a frequency of 28.4 percent in winter and 58.5 percent in summer, in contrast to 42.1 percent and 80.5 percent respectively for the layer surface to 1.5 km. The layer that exhibited the smallest windshear magnitude is 1.5 km to 3 km, with a windshear of less than 15 knots occurring with a frequency of 85.3 percent in winter and 93.3 percent in summer. Only 11.4 percent of all observations of windshear between 1.5 km and 3 km were greater than or equal to 15 knots. The seasonal differences in windshear for this layer are quite evident when considering shears of smaller magnitude, e.g., 28 percent occurrence of windshear less than or equal to 5 knots during winter as compared with 44 percent occurrence during summer. Approximately 17 knots is the 95th percentile of the windshear between 3 km and 5.5 km during summer, but corresponds to the 74th percentile for winter.

Tables 28 through 54 list the vertical differences in windspeed, wind direction, and shear for the various atmospheric layers for the selected thresholds 50, 90, 95, 97.5, and 99%. The windspeed differences between surface and 1.5 km for these thresholds at Berlin are 20.8, 31.4, 38.2, 44.2, and 46.1 knots for January decreasing to 9.5, 18.7, 22.5, 24.0, and 24.2 knots for July (Table 28). The windspeed differences from surface to 3 km for the selected thresholds are 19.0, 35.5, 39.0, 45.5, and 46.0 knots for January, decreasing to 10.0, 21.1, 23.5, 29.3, and 30.0 knots for July (Table 30). The annual average windspeed differences from 1.5 to 3 km are 4.0, 11.0, 13.0, 15.0, and 18.0 knots (Table 32), increasing to 7.0, 20.0, 25.0, 29.0, and 36.0 knots respectively from 3 to 5.5 km for the selected percentile values (Table 33). The 90th percentile of the windspeed difference from 3 to 5.5 km range from 10.0 knots to 26.0 knots (annual average of 20.0 knots). For the layer 1.5 to 3 km, the 90th percentile of windspeed differences range from 17.4 to 31.5 knots (annual average 28.0 knots), as compared with a range of 27.0 to 50.5 knots (annual average 45.0 knots) for the 99th percentile. For the layer surface to 5.5 km, the 90th percentile of windspeed differences range from 27.4 to 55.0 knots (annual average 43.0 knots), with the 99th percentile ranging from 41.0 knots to 70.2 knots (annual average 63.1 knots). Some of the monthly fluctuations in percentile values, particulary the wind direction differences, may be attributed to an increase in wind variability during stable atmospheric conditions when the winds are weak (i.e., during summer, when boundary-layer winds may become uncoupled with winds above). The seasonal variations appear to be realistic, considering the limited period of record, observational errors, etc.

Considering all observations, the wind direction difference percentile values for surface to 1.5 km layer are (in sequence) 30.0, 80.0, 110.0, 135.0, and 160.0 degrees (Table 37). The wind direction difference percentile values are 35.0, 120.0, 145.0, 160.0, and 170.0 degrees from surface to 3 km (Table 39), 15.0, 60.0, 80.0, 105.0, and 145.0 degrees from 1.5 to 3 km, (Table 41) and 10.0, 50.0, 70.0, 96.0, and 130.0 degrees from 3.0 to 5.5 km (Table 42). For the layer 1.5 to 5.5 km (Table 43), the 90th percentile ranges from 67.5 to 121.0 degrees (100 degrees annual average), and the 95th percentile ranges from 87.3 to 150.0 degrees (130 degrees annual average). The wind direction difference percentile values are 45.0, 140.0 160.0, 170.0, and 175.0 degrees (annual averages) for the layer surface to 5.5 km (Table 45). The range of percentile values for the individual months for this layer is fairly small.

The magnitude of the windshear at Berlin in the layer from surface to 1.5 km for the selected thresholds are 20.8, 31.4, 38.2, 44.2, and 46.1 knots for January, decreasing to 9.5, 18.7, 22.5, 24.0, and 24.2 knots for July (Table 46). These shear magnitudes are only slightly higher than the vertical differences in windspeed, but the difference between increase of windspeed in the vertical and vertical windshear is apparently larger for stronger winds (January). The magnitudes of the windshear in the layer from surface to 3 km (Table 48) are 24.1, 41.2, 44.7, 56.4, and 59.9 knots in January, and are 13.1, 24.4, 29.4, 31.8, and 34.4 knots in July for the selected thresholds. The windshears in the layer from 1.5 to 3 km (Table 50) are 7.5, 15.7, 18.5, 21.6, and 24.9 knots, and for the layer from 3 to 5.5 km (Table 51) are 10.5, 22.5, 28.4, 33.7, and 40.0 knots. It is no surprise

that the largest windshear magnitudes are associated with the surface to 5.5 km layer. For this layer, the magnitude of the windshear for the selected thresholds are 31.9, 57.0, 59.6, 76.8, and 77.7 knots in January decreasing to 17.8, 32.6, 38.4, 44.8, and 49.2 knots in July.

IV. SUMMARY

The vertical variation of the horizontal wind (vector windshear) in the troposphere has been studied for one location, Berlin-Templehof airport in Germany. Although studies of this nature are most often made in the boundary layer, data from tropospheric measurements are relatively scant. In this study, the vector windshear represents the deviation of the wind (taking into account both windspeed and direction changes) from one altitude point to another.

Frequency distribution and selected percentile values of the scalar shear, angular differences, and total vector shear for all possible permutations (except surface to 1000mb) for the 5 pressure levels are presented in detail (monthly, seasonal, annual averages): Surface, 1000mb (near surface), 850mb (1.5 km), 700mb (3 km), and 500mb, (5.5 km). Monthly and seasonal variation of these parameters are clearly evident from these data. The 95 percent values of the scalar shear, angular differences, and total vector shear for each of the atmospheric layers are listed below in a summary table.

Summary Table: 95 percent values of the windspeed differences (WSD), wind direction differences (WDD), and windshear (WSH) for the specified atmospheric layers at Berlin, 1200 Hours GMT (1974-78, 1981).

Atmospheric Layer	WSD (Kn)	WDD (Deg)	WSH (Kn)
Surface - 1.5 km	27.0	110.0	29.6
Near surface - 1.5 km	25.0	95.0	28.0
Surface - 3 km	33.0	145.0	21.8
Near surface - 3 km	32.0	140.0	36.3
1.5 - 3 km	13.0	80.0	18.5
3 - 5.5 km	25.0	70.0	28.4
1.5 - 5.5 km	34.0	130.0	40.9
Near surface - 5.5 km	49.0	155.0	53.9
Surface - 5.5 Km	51.0	160.0	55.2

Although surface to 1.5 km and 1.5 to 3 km are both 1.5 km thick layers, the frequency distribution of angular differences, scalar shear, and therefore the vector shear are quite different for these 2 layers. The frequency of occurrence of angular differences of greater than or equal to 30 degrees for the surface to 1.5 km layer in winter is 63.9 percent compared to 22.8 percent for the layer 1.5 to 3 km. The magnitude of the vector windshear is roughly twice as large in the layer surface to 1.5 km compared with the layer 1.5 to 3 km. Therefore, to assume the same change of windspeed and direction (and consequently the same vector shear) for every atmospheric layer of equivalent thickness is not appropriate in many instances when considering the deviation of the wind from one altitude level to another.

The data for this single station in Central Europe may serve as a guide. It is intended to expand this study to other locations.

TABLE 1. Percent Occurrence of the Differences in Windspeed (knots) Between Surface and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GR 15
JANUARY	9.47	3.16	9.47	8.42	9.47	60.00
FEBRUARY	7.92	13.86	16.83	16.83	11.88	32.67
MARCH	10.19	15.74	10.19	16.67	11.11	36.11
APRIL	18.26	14.79	25.22	12.17	17.39	12.17
MAY	16.07	19.64	26.79	17.86	9.82	9.82
JUNE	23.26	19.77	18.60	13.95	15.12	9.30
JULY	13.19	26.37	25.27	12.09	9.89	13.19
AUGUST	7.62	15.24	21.90	24.76	17.14	13.33
SEPTEMBER	13.33	14.07	12.59	19.26	13.33	27.41
OCTOBER	8.15	11.85	17.78	14.07	12.59	35.56
NOVEMBER	5.99	10.26	4.27	13.68	6.84	58.97
DECEMBER	4.49	4.49	6.74	13.48	13.48	57.30
FALL	9.30	12.14	11.87	15.76	11.11	39.79
WINTER	7.37	7.37	11.23	12.94	11.59	49.47
SPRING	14.93	16.72	20.90	15.92	12.84	18.10
SUMMER	14.18	20.21	21.99	17.38	14.18	12.06
ANNUAL	11.40	14.04	16.29	15.44	12.34	30.49

TABLE 2. Percent Occurrence of the Differences in Windspeed (knots) Between 1000mb (Near Surface) and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	10.53	7.37	11.59	7.37	10.53	52.63
FEBRUARY	9.90	19.80	17.82	16.83	13.86	21.78
MARCH	12.04	20.37	12.04	13.89	16.67	25.00
APRIL	21.74	18.26	26.96	6.96	15.65	10.43
MAY	16.96	28.57	21.43	18.75	6.25	8.04
JUNE	23.26	29.07	13.95	16.28	9.30	8.14
JULY	16.48	30.77	21.98	14.29	5.49	10.99
AUGUST	13.33	22.86	20.95	23.81	13.33	5.71
SEPTEMBER	15.56	14.81	22.22	16.30	10.37	20.74
OCTOBER	13.33	17.04	17.78	11.11	14.07	26.67
NOVEMBER	11.11	10.26	5.98	11.11	10.26	51.28
DECEMBER	3.37	10.11	12.36	13.48	7.87	52.81
FALL	13.44	14.21	15.76	12.92	11.63	32.04
WINTER	8.07	12.63	14.04	12.61	10.88	41.75
SPRING	17.01	22.39	20.30	13.13	12.84	14.33
SUMMER	17.36	27.30	19.15	18.44	9.57	8.18
ANNUAL	14.04	19.85	17.30	14.12	11.33	24.36

TABLE 3. Percent Occurrence of the Differences in Windspeed (knots) Between Surface and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981) .

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	2.11	2.11	6.32	10.53	13.68	65.26
FEBRUARY	7.92	10.89	15.84	12.87	10.89	41.58
MARCH	7.41	5.56	12.96	12.04	10.19	51.85
APRIL	14.78	16.52	9.57	16.52	8.70	33.91
MAY	14.29	13.39	13.39	16.96	15.18	26.79
JUNE	16.28	17.44	10.60	13.95	6.98	26.74
JULY	10.99	15.38	10.68	9.89	17.58	27.47
AUGUST	13.33	10.48	11.43	11.43	28.57	24.76
SEPTEMBER	9.63	12.59	10.37	11.85	11.11	44.44
OCTOBER	9.63	9.63	8.89	8.89	11.85	51.11
NOVEMBER	5.13	9.40	7.69	11.97	7.69	58.12
DECEMBER	3.37	5.62	3.37	7.87	16.85	62.92
FALL	8.27	10.59	9.04	10.85	10.34	50.90
WINTER	4.56	6.32	8.77	10.53	13.68	56.14
SPRING	12.24	11.94	11.94	15.22	11.34	37.31
SUMMER	13.48	14.18	15.96	11.70	10.44	26.24
ANNUAL	9.42	10.78	11.25	12.10	13.11	43.13

TABLE 4. Percent Occurrence of the Differences in Windspeed (knots) Between 1000mb (Near Surface) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 9	9 TO 11	12 TO 14	GR 15
JANUARY	4.21	5.26	8.42	11.58	11.58	58.95
FEBRUARY	9.90	10.89	18.81	12.87	10.89	36.63
MARCH	7.41	9.26	13.89	12.96	7.41	49.07
APRIL	18.26	14.52	8.70	15.65	10.43	30.43
MAY	14.29	16.36	17.86	12.50	12.50	25.89
JUNE	18.60	17.44	19.77	11.63	15.12	17.44
JULY	14.29	15.38	18.68	12.09	12.09	27.47
AUGUST	14.29	12.38	17.14	18.10	19.05	19.05
SEPTEMBER	11.85	14.07	7.41	17.04	15.56	34.07
OCTOBER	11.85	13.33	4.44	17.04	8.15	45.19
NOVEMBER	7.69	10.26	8.55	11.97	9.40	52.14
DECEMBER	4.49	5.62	10.11	8.99	15.73	55.06
FALL	10.59	12.66	6.72	15.50	11.11	43.41
WINTER	6.32	7.37	12.63	11.23	12.63	49.82
SPRING	13.43	14.33	13.43	13.73	10.15	34.93
SUMMER	15.60	14.99	18.44	14.18	15.60	21.29
ANNUAL	11.49	12.41	12.34	13.11	12.18	37.78

TABLE 5. Percent Occurrence of the Differences in Windspeed (knots) Between 850mb (1500M) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	33.68	20.00	25.26	10.53	5.26	5.26
FEBRUARY	28.71	24.73	20.79	13.46	8.91	.99
MARCH	26.85	31.48	17.59	11.11	7.41	5.56
APRIL	24.35	37.39	17.39	13.04	5.22	2.61
MAY	33.93	30.36	14.29	16.07	4.46	.89
JUNE	40.84	22.09	15.12	11.63	2.33	0.00
JULY	35.16	30.77	19.78	10.99	2.20	1.10
AUGUST	32.38	38.10	16.19	7.62	4.76	.95
SEPTEMBER	24.44	31.85	20.74	11.11	9.39	2.96
OCTOBER	37.04	27.41	17.78	8.15	5.19	4.44
NOVEMBER	18.80	36.75	19.66	11.97	7.69	5.13
DECEMBER	30.34	34.83	15.73	12.36	2.25	4.49
FALL	27.13	31.78	19.38	10.34	7.24	4.13
WINTER	30.89	27.02	20.70	12.28	5.61	3.51
SPRING	28.34	33.13	16.42	13.43	5.67	2.99
SUMMER	38.30	30.85	17.02	9.93	3.19	.71
ANNUAL	30.72	30.38	18.39	11.48	5.59	2.95

TABLE 6. Percent Occurrence of the Differences in Windspeed (knots) Between 700mb (3000M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	14.74	17.89	16.84	5.25	16.84	28.42
FEBRUARY	12.87	14.85	15.84	24.75	10.89	20.79
MARCH	12.04	20.37	17.59	12.04	12.96	25.00
APRIL	15.65	17.39	17.39	14.78	7.83	26.96
MAY	21.43	24.11	13.39	16.96	3.57	20.54
JUNE	30.23	31.40	19.77	11.63	2.33	4.65
JULY	24.18	28.57	15.38	16.48	9.89	5.49
AUGUST	28.57	21.90	14.29	15.24	12.38	7.62
SEPTEMBER	12.59	24.44	16.30	22.96	8.15	15.56
OCTOBER	17.04	21.48	17.04	17.04	7.41	20.00
NOVEMBER	17.09	12.82	16.24	14.53	14.53	24.79
DECEMBER	11.24	21.35	19.10	13.48	13.48	21.35
FALL	15.50	19.90	16.54	18.35	9.82	19.90
WINTER	12.98	17.89	17.19	14.74	13.68	23.51
SPRING	16.42	20.60	16.12	14.63	8.06	24.18
SUMMER	27.66	26.95	16.31	14.54	8.51	6.03
ANNUAL	17.84	21.19	16.57	15.75	9.93	18.77

TABLE 7. Percent Occurrence of the Differences in Windspeed (knots) Between 850mb (1500M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GR 15
JANUARY	8.42	15.79	11.58	5.26	13.68	45.26
FEBRUARY	10.89	11.88	11.88	10.89	10.89	43.56
MARCH	9.26	11.11	11.11	13.89	7.41	47.22
APRIL	14.78	10.43	9.57	13.91	7.83	43.48
MAY	9.82	11.61	22.32	12.50	11.61	32.14
JUNE	22.09	25.58	13.95	11.63	12.79	13.95
JULY	19.78	21.98	15.38	7.69	12.09	23.08
AUGUST	23.81	16.19	14.29	9.52	11.43	24.76
SEPTEMBER	14.07	11.11	12.59	12.59	8.15	41.48
OCTOBER	15.56	17.04	18.52	8.15	8.15	32.59
NOVEMBER	12.82	13.68	6.84	12.82	7.69	46.15
DECEMBER	11.24	15.73	7.87	14.61	15.73	34.83
FALL	14.21	13.95	12.92	11.11	8.01	39.79
WINTER	10.18	14.39	10.53	10.13	13.33	41.40
SPRING	11.34	11.04	14.33	13.43	8.96	40.90
SUMMER	21.99	20.92	14.54	9.57	12.06	20.92
ANNUAL	14.27	14.82	13.11	11.17	10.32	36.31

TABLE 8. Percent Occurrence of the Differences in Windspeed (knots) Between 1000mb (Near Surface) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	0.00	5.26	2.11	6.32	6.32	80.00
FEBRUARY	7.92	13.86	5.94	3.96	7.92	60.40
MARCH	2.78	5.56	6.48	7.41	8.33	69.44
APRIL	7.83	9.57	8.70	8.70	8.70	56.52
MAY	9.82	11.61	4.46	14.29	10.71	49.11
JUNE	13.95	15.12	12.79	13.95	8.14	36.05
JULY	10.99	7.69	10.99	8.79	15.38	46.15
AUGUST	9.52	12.39	10.48	12.38	9.52	45.71
SEPTEMBER	3.70	4.44	14.07	9.63	8.15	60.00
OCTOBER	5.19	5.93	11.11	8.89	9.15	60.74
NOVEMBER	5.98	5.98	9.40	4.27	5.94	68.38
DECEMBER	3.37	3.37	3.37	3.37	5.62	80.90
FALL	4.91	5.43	11.63	7.78	7.49	62.79
WINTER	3.86	7.72	3.86	4.56	6.67	73.33
SPRING	6.87	8.96	6.57	10.15	9.25	58.21
SUMMER	11.35	11.70	11.35	11.70	10.99	42.91
ANNUAL	6.59	8.22	8.53	8.53	8.53	59.58

TABLE 9. Percent Occurrence of the Differences in Windspeed (knots) Between Surface and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	0.00	4.21	1.05	5.26	6.32	83.16
FEBRUARY	9.90	4.95	6.93	5.94	7.92	64.36
MARCH	.93	6.48	4.63	10.19	5.56	72.22
APRIL	9.57	7.83	5.22	10.43	4.35	62.61
MAY	12.50	8.93	5.36	8.04	15.18	50.00
JUNE	12.79	15.12	10.47	15.12	8.14	38.37
JULY	6.59	8.79	14.29	5.49	14.29	50.55
AUGUST	7.62	10.48	6.67	12.38	13.33	49.52
SEPTEMBER	3.70	5.19	8.15	10.37	8.89	63.70
OCTOBER	3.70	6.67	7.41	6.67	10.37	65.19
NOVEMBER	4.27	4.27	6.84	6.84	7.69	70.09
DECEMBER	1.12	4.49	2.25	4.49	1.12	86.52
FALL	3.38	5.43	7.49	8.01	9.04	66.15
WINTER	3.86	4.56	3.51	5.26	5.26	77.54
SPRING	7.74	7.75	5.07	9.55	9.36	61.49
SUMMER	8.87	11.35	10.29	10.99	12.06	46.49
ANNUAL	5.97	7.14	6.59	8.46	8.69	63.15

TABLE 10. Percent Occurrence of the Differences in Wind Direction (Degrees) Between Surface and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0-29	30-59	60-89	90-119	120-149	150-180
JANUARY	38.95	40.00	13.68	3.16	4.21	0.00
FEBRUARY	37.62	28.71	18.81	5.94	1.98	6.93
MARCH	47.22	35.19	13.89	1.85	.93	.93
APRIL	60.00	28.70	2.61	3.48	2.61	2.61
MAY	52.68	28.57	8.93	4.46	4.46	.89
JUNE	53.49	27.91	8.14	5.81	1.16	3.49
JULY	56.04	26.37	15.38	1.10	1.10	0.00
AUGUST	57.14	29.57	7.62	4.76	1.90	0.00
SEPTEMBER	57.04	20.74	11.85	5.19	3.70	1.48
OCTOBER	45.93	32.59	14.07	1.48	5.19	.74
NOVEMBER	46.15	36.75	11.11	3.42	.85	1.71
DECEMBER	31.46	47.19	14.61	4.49	1.12	1.12
FALL	49.87	29.72	12.40	3.36	3.36	1.29
WINTER	36.14	38.25	15.79	4.56	2.46	2.81
SPRING	53.43	30.75	8.36	3.28	2.69	1.49
SUMMER	55.67	27.66	10.28	3.90	1.42	1.06
ANNUAL	49.03	31.42	11.64	3.72	2.56	1.63

TABLE 11. Percent Occurrence of the Differences in Wind Direction (Degrees) Between 1000mb (Near Surface) and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0-29	30-59	60-89	90-119	120-149	150-180
JANUARY	44.21	36.84	13.68	4.21	1.05	0.00
FEBRUARY	44.55	27.72	14.85	6.93	3.96	1.98
MARCH	52.78	30.56	12.96	2.78	.93	0.00
APRIL	60.87	27.83	4.35	1.74	3.48	1.74
MAY	56.25	28.57	7.14	4.46	3.57	0.00
JUNE	55.81	25.58	9.30	5.81	2.33	1.16
JULY	62.64	25.27	8.79	3.30	0.00	0.00
AUGUST	66.67	22.86	5.71	2.86	.95	.95
SEPTEMBER	59.26	22.96	8.15	6.67	1.48	1.48
OCTOBER	52.59	28.15	13.33	2.96	2.22	.74
NOVEMBER	47.86	41.03	6.84	1.71	2.56	0.00
DECEMBER	37.08	41.57	15.73	3.37	1.12	1.12
FALL	53.49	30.23	9.56	3.88	2.07	.78
WINTER	42.11	35.09	14.74	4.91	2.11	1.05
SPRING	56.72	28.96	8.06	2.79	2.69	.60
SUMMER	62.06	24.47	7.80	3.90	1.06	.71
ANNUAL	53.69	29.71	9.93	3.88	2.02	.78

TABLE 12. Percent Occurrence of the Differences in Wind Direction (Degrees) Between Surface and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0-29	30-59	60-89	90-119	120-149	150-180
JANUARY	27.37	36.84	22.11	4.21	3.16	6.32
FEBRUARY	26.73	28.71	21.78	11.88	5.94	4.95
MARCH	38.89	25.93	13.89	9.26	8.33	3.70
APRIL	36.52	32.17	12.17	5.22	6.96	6.96
MAY	43.75	18.75	16.07	8.93	7.14	5.36
JUNE	37.21	30.23	16.28	2.33	8.14	5.81
JULY	45.05	29.67	12.09	7.69	5.49	0.00
AUGUST	39.05	33.33	11.43	9.52	3.81	2.86
SEPTEMBER	45.19	24.44	6.67	8.15	8.89	6.67
OCTOBER	45.19	27.41	10.37	8.39	4.44	3.70
NOVEMBER	41.03	34.19	15.38	5.13	.85	3.42
DECEMBER	25.84	43.82	16.85	3.37	8.99	1.12
FALL	43.93	28.42	10.59	7.49	4.91	4.65
WINTER	26.67	36.14	20.35	6.67	5.96	4.21
SPRING	39.70	25.67	14.03	7.76	7.46	5.37
SUMMER	40.43	31.21	13.12	6.74	5.67	2.84
ANNUAL	38.25	30.02	14.20	7.21	5.97	4.34

TABLE 13. Percent Occurrence of the Differences in Wind Direction (Degrees) Between 1000mb (Near Surface) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0-29	30-59	60-89	90-119	120-149	150-180
JANUARY	29.47	40.00	16.84	5.26	6.32	2.11
FEBRUARY	24.75	33.66	23.76	9.90	3.96	3.96
MARCH	37.96	29.63	12.04	10.19	6.48	3.70
APRIL	40.00	30.43	11.30	5.22	5.22	7.83
MAY	44.64	20.54	16.96	6.25	6.25	5.36
JUNE	38.37	32.56	10.47	8.14	6.98	3.49
JULY	45.05	32.97	12.09	4.40	4.40	1.10
AUGUST	42.86	30.48	14.29	6.67	1.90	3.81
SEPTEMBER	43.70	25.93	8.15	6.67	8.89	6.67
OCTOBER	41.48	31.85	11.11	8.89	3.70	2.96
NOVEMBER	45.30	35.90	10.26	4.27	.85	3.42
DECEMBER	32.58	41.57	14.61	3.37	5.62	2.25
FALL	43.41	31.01	9.82	6.72	4.65	4.39
WINTER	28.77	38.25	18.60	6.32	5.26	2.81
SPRING	40.90	26.87	13.43	7.16	5.97	5.67
SUMMER	42.20	31.91	12.41	6.38	4.26	2.84
ANNUAL	39.26	31.73	13.27	6.67	5.04	4.03

TABLE 14. Percent Occurrence of the Differences in Wind Direction (Degrees) Between 850mb (1500M) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0-29	30-59	60-89	90-119	120-149	150-180
JANUARY	71.58	21.05	5.24	1.05	1.05	0.00
FEBRUARY	69.31	15.84	10.89	1.98	.99	.99
MARCH	68.52	17.59	9.24	2.78	.93	.93
APRIL	72.17	13.91	7.83	2.61	2.61	.87
MAY	70.54	14.29	10.71	2.68	.89	.89
JUNE	69.77	18.60	4.65	4.65	0.00	2.33
JULY	73.63	19.78	5.49	0.00	0.00	1.10
AUGUST	77.14	15.24	3.81	1.90	1.90	0.00
SEPTEMBER	71.11	17.04	5.19	2.96	1.48	2.22
OCTOBER	77.04	16.30	2.96	3.70	0.00	0.00
NOVEMBER	87.18	6.84	5.13	0.00	.85	0.00
DECEMBER	80.90	13.48	3.37	2.25	0.00	0.00
FALL	78.04	13.70	4.39	2.33	.78	.78
WINTER	73.68	16.84	6.67	1.75	.70	.35
SPRING	70.45	15.22	9.25	2.69	1.49	.90
SUMMER	73.76	17.73	4.61	2.13	.71	1.06
ANNUAL	74.17	15.67	6.21	2.25	.93	.79

TABLE 15. Percent Occurrence of the Differences in Wind Direction (Degrees) Between 700mb (3000M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0-29	30-59	60-89	90-119	120-149	150-180
JANUARY	62.11	14.74	9.16	0.00	0.00	0.00
FEBRUARY	67.33	16.83	10.89	3.96	.99	0.00
MARCH	80.56	13.89	3.70	0.00	1.85	0.00
APRIL	70.43	19.13	6.96	2.61	.87	0.00
MAY	72.32	19.64	4.46	.89	1.79	.89
JUNE	69.77	18.60	3.49	3.49	2.33	2.33
JULY	83.52	12.09	1.10	1.10	1.10	1.10
AUGUST	81.90	12.38	2.86	1.90	0.00	.95
SEPTEMBER	80.74	14.07	2.22	2.22	.74	0.00
OCTOBER	77.78	11.11	7.41	.74	.74	2.22
NOVEMBER	84.62	9.40	3.42	.85	1.71	0.00
DECEMBER	93.15	11.24	4.49	1.12	0.00	0.00
FALL	80.83	11.63	4.39	1.29	1.03	.78
WINTER	77.19	14.33	6.32	1.75	.35	0.00
SPRING	74.33	17.61	5.07	1.19	1.49	.30
SUMMER	78.72	14.18	2.48	2.13	1.06	1.42
ANNUAL	77.89	14.35	4.58	1.55	1.01	.62

TABLE 16. Percent Occurrence of the Differences in Wind Direction (Degrees) Between 850mb (1500M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0-29	30-59	60-89	90-119	120-149	150-180
JANUARY	55.79	27.37	10.53	3.16	2.11	1.05
FEBRUARY	47.52	21.78	10.89	9.90	4.95	4.95
MARCH	50.00	23.15	12.96	6.48	2.78	4.63
APRIL	48.70	23.48	13.04	4.35	6.09	4.35
MAY	50.00	21.43	10.71	6.25	5.36	6.25
JUNE	47.67	25.58	10.47	5.81	5.81	4.65
JULY	62.64	20.88	8.79	3.30	1.10	3.30
AUGUST	52.38	31.43	4.76	4.76	3.81	2.86
SEPTEMBER	55.56	22.96	11.11	5.93	2.96	1.48
OCTOBER	54.07	22.22	12.59	6.67	2.96	1.48
NOVEMBER	70.09	19.66	3.42	3.42	1.71	1.71
DECEMBER	65.17	16.85	13.48	1.12	2.25	1.12
FALL	59.43	21.71	9.30	5.43	2.58	1.55
WINTER	55.79	22.11	11.58	4.91	3.16	2.46
SPRING	49.55	22.69	12.24	5.67	4.74	5.07
SUMMER	54.26	26.24	7.80	4.61	3.55	3.55
ANNUAL	54.93	23.04	10.24	5.20	3.49	3.10

TABLE 17. Percent Occurrence of the Differences in Wind Direction (Degrees) Between 1000mb (Near Surface) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0-29	30-59	60-89	90-119	120-149	150-180
JANUARY	29.47	31.58	18.95	7.37	6.32	6.32
FEBRUARY	24.75	22.77	15.84	17.82	12.87	5.94
MARCH	30.56	24.07	12.04	14.81	11.11	7.41
APRIL	30.43	28.70	8.70	11.30	12.17	8.70
MAY	29.46	29.46	9.93	9.82	11.61	10.71
JUNE	32.56	25.58	15.12	5.81	8.14	12.79
JULY	41.76	28.57	10.99	7.69	5.49	5.49
AUGUST	35.24	29.52	17.14	7.62	4.76	5.71
SEPTEMBER	36.30	24.44	14.81	8.89	6.67	8.89
OCTOBER	35.56	23.70	14.81	14.07	5.19	6.67
NOVEMBER	36.75	31.62	15.38	7.69	5.13	3.42
DECEMBER	31.46	30.34	17.99	10.11	5.62	4.49
FALL	36.18	26.36	14.99	10.34	5.68	6.46
WINTER	28.42	28.07	17.54	11.93	8.42	5.61
SPRING	30.15	27.46	9.85	11.94	11.64	8.96
SUMMER	36.52	29.01	14.54	7.09	6.03	7.80
ANNUAL	32.97	27.39	14.12	10.40	7.91	7.21

TABLE 18. Percent Occurrence of the Differences in Wind Direction (Degrees) Between Surface and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0-29	30-59	60-89	90-119	120-149	150-180
JANUARY	26.32	31.58	22.11	6.32	6.32	7.37
FEBRUARY	25.74	18.81	14.85	17.82	18.81	3.96
MARCH	30.56	23.15	12.04	12.96	12.04	9.26
APRIL	30.43	25.22	12.17	12.17	11.30	8.70
MAY	30.36	23.21	11.61	10.71	8.93	15.18
JUNE	31.40	17.44	22.09	9.30	5.81	13.95
JULY	39.56	29.67	12.09	7.69	6.59	4.40
AUGUST	35.24	27.62	15.24	10.48	5.71	5.71
SEPTEMBER	33.33	28.15	13.33	7.41	11.11	6.67
OCTOBER	33.33	26.67	14.91	11.85	8.15	5.19
NOVEMBER	36.75	29.06	13.68	10.26	5.98	4.27
DECEMBER	28.09	26.97	22.47	11.24	4.49	6.74
FALL	34.37	27.91	13.95	9.82	8.53	5.43
WINTER	26.67	25.61	19.65	11.93	10.18	5.96
SPRING	30.45	23.88	11.94	11.94	10.75	11.04
SUMMER	35.46	25.18	16.31	9.22	6.03	7.80
ANNUAL	31.89	25.76	15.21	10.71	8.92	7.53

TABLE 19. Percent Occurrence of the Windshear (knots) Between Surface and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	4.21	4.21	7.37	10.53	3.16	70.53
FEBRUARY	2.97	6.93	13.86	16.83	18.81	40.59
MARCH	1.85	9.26	12.96	19.44	14.81	41.67
APRIL	7.83	14.78	20.87	20.00	15.65	20.87
MAY	7.14	16.07	25.00	19.64	13.39	18.75
JUNE	9.30	16.28	17.44	20.93	17.44	18.60
JULY	5.49	19.78	19.78	23.08	12.09	19.78
AUGUST	4.76	10.48	20.00	22.86	21.90	20.00
SEPTEMBER	3.70	13.33	12.59	18.52	17.78	34.07
OCTOBER	3.70	8.15	15.56	15.56	14.07	42.96
NOVEMBER	.85	6.84	7.69	12.82	6.84	64.96
DECEMBER	0.00	2.25	8.99	11.24	13.48	64.04
FALL	2.84	9.56	12.14	15.76	13.18	46.51
WINTER	2.46	4.56	10.18	12.98	11.93	57.89
SPRING	5.67	13.43	19.70	19.70	14.63	26.87
SUMMER	6.38	15.25	19.15	22.34	17.38	19.50
ANNUAL	4.27	10.71	15.21	17.61	14.20	38.01

TABLE 20. Percent Occurrence of the Windshear (knots) Between 1000mb (Near Surface) and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	4.21	5.26	9.47	8.42	11.58	61.05
FEBRUARY	4.95	9.90	14.85	19.80	17.82	32.67
MARCH	2.78	10.19	17.59	19.44	18.52	31.48
APRIL	10.43	15.65	23.48	16.52	16.52	17.39
MAY	6.25	24.11	21.43	20.54	13.39	14.29
JUNE	10.47	19.77	18.60	19.77	16.28	15.12
JULY	7.69	23.08	24.18	23.08	6.59	15.38
AUGUST	7.62	16.19	20.95	25.71	15.24	14.29
SEPTEMBER	4.44	14.07	20.00	19.26	14.81	27.41
OCTOBER	4.44	13.33	14.81	17.04	17.04	33.33
NOVEMBER	1.71	7.69	10.26	11.97	6.84	61.54
DECEMBER	0.00	3.37	7.87	20.22	8.99	59.55
FALL	3.62	11.89	15.25	16.23	13.18	39.79
WINTER	3.16	6.32	10.88	16.14	12.98	50.53
SPRING	6.57	16.72	20.90	18.81	16.12	20.90
SUMMER	8.51	19.50	21.28	23.05	12.77	14.89
ANNUAL	5.35	13.59	17.07	18.39	13.81	31.81

TABLE 21. Percent Occurrence of the Windshear (knots) Between Surface and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	1.05	0.00	3.16	7.37	7.37	81.05
FEBRUARY	1.98	6.93	9.90	10.89	15.84	54.46
MARCH	.93	3.70	5.56	8.33	12.96	68.52
APRIL	2.61	5.22	16.52	16.52	9.57	49.57
MAY	4.46	6.25	10.71	20.54	16.07	41.96
JUNE	4.65	9.30	19.77	10.47	16.28	39.53
JULY	3.30	8.79	15.38	15.38	15.38	41.76
AUGUST	3.81	4.76	16.19	13.33	19.05	42.86
SEPTEMBER	.74	5.19	10.37	14.81	11.85	57.04
OCTOBER	3.70	7.41	6.67	10.37	10.37	61.48
NOVEMBER	0.00	4.27	7.69	6.84	11.11	70.09
DECEMBER	0.00	2.25	1.12	5.62	10.11	80.90
FALL	1.55	5.69	8.27	10.85	11.11	62.53
WINTER	1.05	3.16	4.91	8.07	11.23	71.58
SPRING	2.69	5.07	11.04	15.22	12.84	53.13
SUMMER	3.90	7.45	17.02	13.12	17.02	41.49
ANNUAL	2.25	5.35	10.16	11.87	12.88	57.49

TABLE 22. Percent Occurrence of the Windshear (knots) Between 1000mb (Near Surface) and 700mb (3000M) at Berlin. 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	1.05	1.05	4.21	7.37	8.42	77.89
FEBRUARY	2.97	4.95	10.89	10.89	17.82	52.48
MARCH	0.00	5.48	6.48	9.26	12.04	65.74
APRIL	.87	7.83	14.79	18.26	10.43	47.83
MAY	5.36	6.25	14.29	16.96	18.75	38.39
JUNE	4.65	9.30	23.26	10.47	16.28	36.05
JULY	1.10	12.09	19.79	15.33	15.38	36.26
AUGUST	1.90	8.57	17.14	14.29	22.86	35.24
SEPTEMBER	1.48	8.15	7.41	17.78	13.33	51.85
OCTOBER	2.96	9.63	7.41	13.33	9.63	57.04
NOVEMBER	0.00	5.98	5.98	8.55	12.82	66.67
DECEMBER	0.00	3.37	2.25	10.11	10.11	74.15
FALL	1.55	3.01	6.98	13.44	11.89	58.14
WINTER	1.40	3.16	5.96	9.47	12.28	67.72
SPRING	2.09	6.87	11.94	14.93	13.73	50.45
SUMMER	2.48	9.93	19.86	13.48	18.44	35.82
ANNUAL	1.86	7.06	10.86	12.95	13.89	53.37

TABLE 23. Percent Occurrence of the Windshear (knots) Between 850mb (1500M) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	6.32	17.89	28.42	15.79	10.53	21.05
FEBRUARY	9.90	19.80	24.75	21.78	10.89	12.87
MARCH	9.26	22.22	20.37	20.37	7.41	20.37
APRIL	8.70	24.35	25.22	19.13	13.04	9.57
MAY	9.82	29.46	16.96	25.00	11.61	7.14
JUNE	11.63	33.72	29.07	16.28	4.65	4.65
JULY	13.19	31.87	23.08	18.68	5.49	7.69
AUGUST	12.38	29.52	30.48	12.38	7.62	7.62
SEPTEMBER	11.11	25.19	22.22	14.07	14.07	13.33
OCTOBER	14.81	22.22	24.44	14.07	11.85	12.59
NOVEMBER	4.27	29.91	26.50	16.24	12.82	10.26
DECEMBER	5.62	23.60	35.96	14.61	10.11	10.11
FALL	10.34	25.58	24.29	14.73	12.92	12.14
WINTER	7.37	20.35	29.47	17.54	10.53	14.74
SPRING	9.25	25.37	20.90	21.49	10.75	12.24
SUMMER	12.41	31.56	27.66	15.60	6.03	6.74
ANNUAL	9.85	25.68	25.29	17.30	10.32	11.56

TABLE 24. Percent Occurrence of the Windshear (knots) Between 700mb (3000M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	0.00	1.05	0.00	4.21	4.21	90.53
FEBRUARY	0.00	4.95	4.95	1.98	11.88	76.24
MARCH	0.00	.93	1.85	5.56	5.56	86.11
APRIL	.87	5.22	4.35	5.22	7.83	76.52
MAY	2.68	4.46	4.46	5.36	18.75	64.29
JUNE	1.16	9.14	10.47	8.14	16.28	55.81
JULY	1.10	6.59	7.69	8.79	10.99	64.84
AUGUST	1.90	4.76	7.62	8.57	12.38	64.76
SEPTEMBER	1.48	.74	3.70	3.70	8.89	81.48
OCTOBER	0.00	3.70	2.96	7.41	11.11	74.81
NOVEMBER	0.00	.85	3.42	7.69	5.98	82.05
DECEMBER	0.00	2.25	0.00	0.00	4.49	93.26
FALL	.52	1.81	3.36	6.20	8.79	79.33
WINTER	0.00	2.91	1.75	2.11	7.02	86.22
SPRING	1.19	3.58	3.59	5.37	10.75	75.52
SUMMER	1.42	6.38	8.51	8.51	13.12	62.06
ANNUAL	.78	3.49	4.19	5.59	9.45	76.11

TABLE 25. Percent Occurrence of the Windshear (knots) Between 850mb (1500M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	0.00	0.00	2.11	3.16	5.26	89.47
FEBRUARY	.99	2.97	5.94	6.93	6.93	76.24
MARCH	.93	0.00	2.78	4.63	4.63	87.04
APRIL	.87	5.22	6.96	4.35	5.22	77.39
MAY	3.57	3.57	2.68	8.93	15.18	66.07
JUNE	1.16	6.98	9.30	12.79	15.12	54.65
JULY	2.20	5.49	9.89	6.59	10.99	64.84
AUGUST	2.86	3.81	7.62	10.48	13.33	61.90
SEPTEMBER	2.22	0.00	4.44	4.44	10.37	78.52
OCTOBER	.74	2.22	2.96	10.37	9.63	74.07
NOVEMBER	.85	.85	4.27	4.27	6.44	82.91
DECEMBER	0.00	2.25	0.00	0.00	2.25	95.51
FALL	1.29	1.03	3.88	6.46	9.04	78.29
WINTER	.35	1.75	2.81	3.51	4.91	86.67
SPRING	1.79	2.99	4.19	5.97	8.36	76.72
SUMMER	2.13	5.32	8.87	9.93	13.12	60.64
ANNUAL	1.40	2.64	4.81	6.44	8.84	75.87

TABLE 26. Percent Occurrence of the Windshear (knots) Between 1000mb (Near Surface) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	1.05	9.47	5.26	5.26	11.58	67.37
FEBRUARY	1.96	4.95	10.89	5.94	14.85	61.39
MARCH	0.00	5.48	6.48	12.04	8.33	66.67
APRIL	4.35	9.57	6.96	5.22	7.83	66.09
MAY	.89	5.36	11.61	17.86	14.29	50.00
JUNE	0.00	10.47	22.09	19.77	15.12	32.56
JULY	8.79	12.09	12.09	12.09	12.09	42.86
AUGUST	3.81	12.38	12.38	17.14	10.48	43.81
SEPTEMBER	2.22	10.37	7.41	10.37	10.37	59.26
OCTOBER	1.48	5.93	14.81	10.37	10.37	57.04
NOVEMBER	4.27	1.71	8.55	10.26	10.26	64.96
DECEMBER	0.00	3.37	4.49	11.24	19.10	61.80
FALL	2.56	6.20	10.34	10.34	10.34	60.21
WINTER	1.05	5.96	7.02	7.37	15.09	63.51
SPRING	1.79	7.16	8.36	11.64	10.15	60.90
SUMMER	4.26	11.70	15.25	16.31	12.41	40.07
ANNUAL	2.40	7.60	10.16	11.33	11.79	56.71

TABLE 27. Percent Occurrence of the Windshear (knots) Between Surface and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1984).

	0 TO 2	3 TO 5	6 TO 8	9 TO 11	12 TO 14	GE 15
JANUARY	4.21	11.58	18.95	9.47	15.79	40.00
FEBRUARY	2.97	11.88	15.84	22.77	13.86	32.67
MARCH	4.63	9.26	16.67	14.81	19.44	35.19
APRIL	7.83	14.78	10.43	20.97	11.30	34.78
MAY	9.82	16.07	17.86	17.86	8.93	29.46
JUNE	8.14	30.23	27.91	15.12	9.30	9.30
JULY	16.48	20.88	15.48	23.08	9.89	13.19
AUGUST	12.38	20.95	20.95	13.33	17.14	15.24
SEPTEMBER	3.70	17.78	19.26	22.22	9.63	27.41
OCTOBER	4.44	15.56	17.04	19.26	16.30	27.41
NOVEMBER	2.56	15.38	13.68	18.80	11.97	37.61
DECEMBER	1.12	8.99	22.47	15.73	12.36	39.33
FALL	3.62	16.29	16.90	20.16	12.66	30.49
WINTER	2.81	10.88	18.95	16.14	14.04	37.19
SPRING	7.46	13.43	14.93	17.91	13.13	33.13
SUMMER	12.41	23.76	21.63	17.02	12.41	12.77
ANNUAL	6.36	15.98	17.84	18.00	13.03	28.78

TABLE 28. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Windspeed (knots) Between Surface and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	17.5	28.5	35.0	39.4	40.0
FEBRUARY	10.0	24.0	27.0	29.0	32.0
MARCH	11.0	25.0	27.4	35.3	44.0
APRIL	7.5	16.0	19.3	20.1	24.5
MAY	7.0	14.2	18.0	19.4	21.4
JUNE	6.0	14.0	18.6	20.9	26.3
JULY	6.0	17.0	19.0	20.3	21.0
AUGUST	9.0	15.5	18.3	20.0	21.0
SEPTEMBER	10.0	24.0	27.0	30.4	34.1
OCTOBER	11.0	22.5	27.0	34.9	39.8
NOVEMBER	17.0	27.0	30.0	31.0	34.0
DECEMBER	18.0	27.0	37.0	38.9	42.0
WINTER	14.0	27.0	32.0	37.1	42.0
SPRING	8.0	18.0	21.5	25.0	30.4
SUMMER	8.0	16.0	19.0	20.0	24.4
FALL	12.0	24.0	28.0	31.0	36.3
ANNUAL	10.0	23.0	27.0	31.0	37.1

TABLE 29. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Windspeed (knots) Between 1000mb (Near Surface) and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	15.5	26.0	32.0	37.0	37.0
FEBRUARY	9.0	20.1	24.0	29.4	32.0
MARCH	10.0	22.2	25.8	35.3	40.0
APRIL	6.0	14.5	19.0	20.1	23.2
MAY	6.0	14.0	16.8	18.0	18.4
JUNE	5.0	13.0	17.3	20.1	26.0
JULY	6.0	15.1	17.0	18.3	19.0
AUGUST	7.0	12.5	16.0	17.4	20.0
SEPTEMBER	8.0	20.5	24.0	27.3	32.9
OCTOBER	9.0	20.5	25.0	31.1	35.4
NOVEMBER	15.0	24.0	27.2	30.0	33.2
DECEMBER	15.5	27.0	35.0	38.1	42.0
WINTER	12.0	26.0	32.0	35.3	40.3
SPRING	7.0	16.0	20.0	24.0	35.4
SUMMER	6.0	13.0	17.0	18.0	20.7
FALL	10.0	21.0	27.0	29.3	33.1
ANNUAL	8.0	21.0	25.0	28.2	35.0

TABLE 30. 50, 90, 95, 97.5, and 99th Percentile Values of the Difference in Windspeed (knots) Between Surface and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	19.0	35.5	39.0	45.5	46.0
FEBRUARY	12.0	28.1	30.0	36.0	38.0
MARCH	15.0	27.0	34.2	38.2	46.0
APRIL	10.5	23.0	25.5	28.1	31.2
MAY	9.0	20.0	22.0	23.2	25.4
JUNE	8.0	20.6	27.0	29.6	33.7
JULY	10.0	21.1	23.5	29.3	30.0
AUGUST	12.0	19.5	24.0	27.0	28.0
SEPTEMBER	12.5	31.0	33.0	41.5	46.0
OCTOBER	15.0	28.5	32.3	38.4	44.4
NOVEMBER	18.5	34.0	38.2	40.0	44.1
DECEMBER	18.0	33.0	41.9	44.7	47.0
WINTER	16.0	33.0	36.3	43.1	47.0
SPRING	11.0	24.0	27.0	31.4	39.1
SUMMER	10.0	21.2	24.2	28.0	30.4
FALL	15.0	32.0	35.1	40.0	44.1
ANNUAL	13.0	28.0	33.0	39.0	44.0

TABLE 31. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Windspeed (knots) Between 1000mb (Near Surface) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	17.0	35.0	37.0	45.5	48.0
FEBRUARY	11.0	25.1	29.0	32.9	38.0
MARCH	13.0	26.0	32.4	34.6	43.0
APRIL	9.0	23.0	24.3	28.0	31.1
MAY	8.0	20.0	21.4	23.0	24.1
JUNE	7.0	19.6	26.3	28.5	31.7
JULY	9.0	20.1	22.5	25.6	30.0
AUGUST	10.0	16.5	22.0	23.0	25.0
SEPTEMBER	11.0	26.5	32.0	38.1	44.1
OCTOBER	13.5	26.5	32.0	35.1	38.0
NOVEMBER	16.0	32.0	37.2	39.0	42.4
DECEMBER	16.0	31.0	40.5	44.2	45.2
WINTER	14.5	30.0	36.3	41.4	47.0
SPRING	10.0	23.0	25.3	30.8	36.4
SUMMER	9.0	19.0	23.0	27.0	30.0
FALL	13.0	29.3	34.0	38.0	40.0
ANNUAL	11.5	26.0	32.0	36.0	40.1

TABLE 32. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Windspeed (knots) Between 850mb (1500M) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	5.0	11.5	14.3	18.4	19.0
FEBRUARY	4.5	11.1	12.0	13.0	13.0
MARCH	5.0	12.0	16.0	17.9	24.0
APRIL	4.0	10.5	13.3	14.3	17.2
MAY	3.0	10.0	11.4	13.0	14.1
JUNE	2.0	10.0	10.3	11.3	13.0
JULY	4.0	9.1	10.5	12.0	12.0
AUGUST	3.5	9.5	12.0	13.0	14.0
SEPTEMBER	4.5	12.0	13.0	14.4	16.1
OCTOBER	4.0	11.5	14.0	18.4	20.4
NOVEMBER	5.0	12.0	14.2	18.0	20.0
DECEMBER	4.0	10.0	12.9	15.2	16.2
WINTER	4.0	11.0	13.0	15.1	19.4
SPRING	4.0	11.0	13.0	16.0	18.7
SUMMER	3.0	10.0	11.0	12.0	13.2
FALL	5.0	12.0	14.0	17.3	19.1
ANNUAL	4.0	11.0	13.0	15.0	18.0

TABLE 33. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Windspeed (knots) Between 700mb (3000M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	9.0	21.0	26.3	30.5	33.0
FEBRUARY	9.0	21.0	26.0	32.3	39.0
MARCH	8.0	19.2	22.8	26.6	36.0
APRIL	8.5	26.0	32.0	34.4	45.2
MAY	6.0	20.0	21.4	25.4	28.6
JUNE	4.0	10.0	15.2	20.2	21.3
JULY	5.0	12.0	14.5	18.3	19.0
AUGUST	5.0	13.5	16.0	17.4	23.0
SEPTEMBER	8.0	19.0	26.0	38.0	50.0
OCTOBER	7.5	22.5	27.3	34.0	35.8
NOVEMBER	9.0	22.0	27.2	28.0	35.9
DECEMBER	8.0	19.0	22.9	25.5	27.4
WINTER	9.0	21.0	25.3	29.0	36.2
SPRING	8.0	21.0	26.3	32.0	37.4
SUMMER	5.0	13.0	15.0	18.0	23.0
FALL	8.0	21.0	28.0	30.7	39.1
ANNUAL	7.0	20.0	25.0	29.0	36.0

TABLE 34. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Windspeed (knots) Between 850mb (1500M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	13.5	31.0	36.5	43.9	47.0
FEBRUARY	12.5	28.2	33.0	39.4	45.0
MARCH	14.0	28.0	33.4	39.6	41.0
APRIL	12.0	31.5	41.3	47.1	50.5
MAY	10.0	27.2	30.4	34.2	38.5
JUNE	6.0	17.4	24.6	29.2	30.0
JULY	7.0	19.1	22.9	26.3	27.0
AUGUST	7.0	20.0	24.3	27.4	33.0
SEPTEMBER	11.0	30.5	34.0	40.4	46.8
OCTOBER	8.0	29.5	37.5	44.4	46.5
NOVEMBER	13.0	31.3	37.2	41.0	42.7
DECEMBER	11.5	23.0	28.5	30.7	34.8
WINTER	13.0	28.5	33.3	41.1	47.3
SPRING	11.5	29.0	34.0	41.4	47.4
SUMMER	7.0	20.0	24.0	27.0	30.5
FALL	11.0	30.3	37.0	41.0	45.1
ANNUAL	11.0	28.0	34.0	40.2	45.0

TABLE 35. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Windspeed (knots) Between 1000mb (Near Surface) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	26.5	49.0	56.0	62.9	66.0
FEBRUARY	19.5	40.1	45.0	49.0	53.0
MARCH	21.0	41.0	50.4	53.3	56.0
APRIL	17.0	41.5	49.0	53.1	69.2
MAY	14.0	33.4	36.0	43.2	48.6
JUNE	10.0	26.2	42.6	46.0	46.4
JULY	13.5	28.1	34.5	43.6	45.0
AUGUST	13.5	27.5	35.0	38.0	40.0
SEPTEMBER	18.5	45.5	51.0	55.0	56.7
OCTOBER	18.0	44.0	54.5	60.4	62.4
NOVEMBER	24.0	51.6	58.2	60.0	61.2
DECEMBER	24.5	47.0	54.8	60.2	61.9
WINTER	25.0	45.0	53.0	57.4	65.2
SPRING	18.0	38.0	46.0	53.0	59.2
SUMMER	13.0	28.0	35.2	43.0	46.0
FALL	20.0	46.0	55.0	59.0	61.0
ANNUAL	19.0	41.0	49.0	55.0	61.0

TABLE 36. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Windspeed (knots) Between Surface and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	26.0	51.5	56.3	66.0	66.0
FEBRUARY	22.0	41.1	45.0	53.0	57.0
MARCH	23.0	42.6	51.0	54.8	59.0
APRIL	18.5	42.5	52.0	53.3	70.2
MAY	14.0	34.2	38.0	43.3	50.4
JUNE	11.0	27.4	44.6	47.2	48.3
JULY	15.0	30.1	36.9	44.1	47.0
AUGUST	14.0	29.0	35.5	39.1	41.0
SEPTEMBER	19.5	47.0	53.0	55.4	57.1
OCTOBER	20.0	46.0	59.0	61.4	67.2
NOVEMBER	26.0	55.0	59.3	64.0	64.0
DECEMBER	27.0	46.0	55.9	62.2	63.9
WINTER	26.0	47.0	55.3	57.6	66.0
SPRING	19.0	39.0	47.8	53.0	62.5
SUMMER	14.0	29.0	37.1	44.0	48.0
FALL	22.0	49.0	56.4	61.0	64.0
ANNUAL	20.0	43.0	51.0	57.0	63.1

TABLE 37. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Wind Direction (Degrees) Between Surface and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	35.0	80.0	111.3	128.3	135.0
FEBRUARY	35.0	100.5	150.0	167.4	170.0
MARCH	30.0	70.0	85.0	89.5	110.0
APRIL	20.0	62.5	115.0	145.6	166.5
MAY	25.0	82.0	119.0	135.3	143.0
JUNE	20.0	86.0	118.0	150.3	158.5
JULY	25.0	65.0	77.2	89.6	115.0
AUGUST	20.0	70.0	91.3	101.7	130.0
SEPTEMBER	22.5	92.5	112.5	145.0	176.8
OCTOBER	30.0	82.5	120.0	136.9	153.8
NOVEMBER	30.0	70.0	90.0	110.0	153.4
DECEMBER	35.0	80.0	100.0	109.0	142.2
WINTER	35.0	87.5	125.0	150.0	165.8
SPRING	25.0	75.0	110.0	135.0	155.3
SUMMER	20.0	75.0	95.0	115.0	141.8
FALL	30.0	76.5	110.0	135.0	152.6
ANNUAL	30.0	80.0	110.0	135.0	160.0

TABLE 38. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Wind Direction (Degrees) Between 1000mb (Near Surface) and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	32.5	79.0	86.3	105.6	115.0
FEBRUARY	35.0	95.5	125.0	140.0	150.0
MARCH	25.0	65.0	80.0	94.5	110.0
APRIL	20.0	60.0	108.8	140.6	166.5
MAY	20.0	81.0	105.0	121.0	126.8
JUNE	20.0	79.0	101.5	123.0	144.9
JULY	22.5	60.5	77.2	96.9	115.0
AUGUST	20.0	57.5	82.5	97.5	135.0
SEPTEMBER	25.0	90.0	110.0	123.8	162.0
OCTOBER	25.0	75.0	92.5	121.9	140.3
NOVEMBER	30.0	60.0	75.7	95.9	127.6
DECEMBER	35.0	70.0	90.0	110.1	148.3
WINTER *	35.0	80.0	100.0	125.3	145.5
SPRING	25.0	70.0	105.0	125.0	141.5
SUMMER	20.0	66.0	90.0	110.0	135.9
FALL	25.0	70.0	96.8	120.0	135.7
ANNUAL	25.0	70.0	95.0	120.0	140.0

TABLE 39. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Wind Direction (Degrees) Between Surface and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	45.0	107.5	151.3	166.9	170.0
FEBRUARY	45.0	120.0	145.0	169.2	180.0
MARCH	35.0	120.0	137.0	148.0	160.0
APRIL	35.0	132.5	155.0	161.3	170.8
MAY	35.0	131.0	149.0	167.0	180.0
JUNE	35.0	130.0	150.0	155.2	161.4
JULY	30.0	90.0	119.5	137.8	145.0
AUGUST	35.0	95.0	126.3	147.5	160.0
SEPTEMBER	40.0	137.5	152.5	163.8	180.0
OCTOBER	35.0	110.0	122.5	155.6	166.8
NOVEMBER	32.5	85.0	105.8	150.0	167.6
DECEMBER	45.0	100.0	134.5	141.1	147.8
WINTER	45.0	120.0	141.3	165.0	175.8
SPRING	35.0	127.5	150.0	161.9	175.0
SUMMER	35.0	100.0	135.0	150.0	160.0
FALL	35.0	111.5	145.0	160.0	170.7
ANNUAL	35.0	120.0	145.0	160.0	170.0

TABLE 40. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Wind Direction (Degrees) Between 1000mb (Near Surface) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	40.0	100.0	122.5	143.3	150.0
FEBRUARY	45.0	100.0	140.0	154.8	180.0
MARCH	35.0	115.0	132.0	155.0	165.0
APRIL	35.0	122.5	155.3	165.6	170.8
MAY	35.0	120.0	149.0	165.0	180.0
JUNE	35.0	121.0	141.5	150.0	150.0
JULY	30.0	85.5	117.3	135.0	135.0
AUGUST	35.0	90.0	128.8	156.9	170.0
SEPTEMBER	35.0	135.0	156.3	170.0	176.8
OCTOBER	35.0	107.5	121.3	153.8	166.4
NOVEMBER	30.0	81.5	100.8	155.0	175.9
DECEMBER	40.0	90.0	129.5	139.4	152.2
WINTER	40.0	100.0	131.3	150.0	170.0
SPRING	35.0	120.0	151.3	165.0	171.8
SUMMER	35.0	97.0	130.5	150.0	160.0
FALL	35.0	106.5	145.0	161.6	170.7
ANNUAL	35.0	110.0	140.0	160.0	170.0

TABLE 41. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Wind Direction (Degrees) Between 850mb (1500M) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	15.0	45.0	62.5	87.5	100.0
FEBRUARY	15.0	70.0	75.0	97.4	130.0
MARCH	15.0	70.0	88.0	115.0	145.0
APRIL	15.0	65.0	91.2	122.5	147.3
MAY	20.0	75.0	85.0	98.0	141.8
JUNE	15.0	60.0	98.0	116.8	157.8
JULY	10.0	40.5	65.0	77.8	85.0
AUGUST	15.0	55.0	68.8	121.9	120.0
SEPTEMBER	15.0	67.5	101.3	148.8	162.0
OCTOBER	15.0	42.5	68.8	93.8	105.0
NOVEMBER	10.0	31.5	60.0	65.0	91.1
DECEMBER	10.0	45.0	65.0	74.5	91.6
WINTER	10.0	55.0	71.3	90.0	108.8
SPRING	15.0	65.0	86.2	116.9	148.5
SUMMER	15.0	55.0	75.0	110.0	146.8
FALL	10.0	46.5	76.8	101.6	145.0
ANNUAL	15.0	60.0	80.0	105.0	145.0

TABLE 42. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Wind Direction (Degrees) Between 700mb (3000M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	10.0	37.5	45.0	76.3	80.0
FEBRUARY	15.0	70.5	85.0	97.4	105.0
MARCH	15.0	41.0	64.0	76.5	145.0
APRIL	15.0	57.5	68.8	91.3	116.5
MAY	15.0	51.0	68.0	96.0	129.8
JUNE	15.0	87.0	119.5	138.0	156.5
JULY	10.0	35.0	50.0	101.9	120.0
AUGUST	15.0	45.0	70.0	85.6	110.0
SEPTEMBER	12.5	50.0	57.5	95.6	110.3
OCTOBER	10.0	60.0	65.0	101.3	151.8
NOVEMBER	10.0	36.3	60.7	80.0	130.0
DECEMBER	10.0	45.0	62.3	66.1	74.9
WINTER	10.0	50.0	71.3	85.0	100.8
SPRING	15.0	50.0	66.3	93.8	132.0
SUMMER	10.0	45.0	71.0	115.0	158.6
FALL	10.0	50.0	65.0	94.9	130.0
ANNUAL	10.0	50.0	70.0	96.1	130.0

TABLE 43. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Wind Direction (Degrees) Between 850mb (1500M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	25.0	67.5	90.0	131.9	135.0
FEBRUARY	32.5	111.0	145.0	152.4	165.0
MARCH	25.0	96.0	141.0	161.5	165.0
APRIL	30.0	120.0	137.5	156.9	170.0
MAY	25.0	121.0	150.0	151.0	170.6
JUNE	30.0	121.0	148.0	165.8	170.7
JULY	20.0	75.3	99.0	154.4	160.0
AUGUST	25.0	90.0	126.3	142.5	160.0
SEPTEMBER	25.0	92.5	111.3	141.9	170.3
OCTOBER	22.5	110.0	115.0	140.3	148.5
NOVEMBER	20.0	59.0	106.5	120.0	166.7
DECEMBER	20.0	75.0	87.3	128.4	141.7
WINTER	25.0	90.0	126.3	145.9	156.5
SPRING	30.0	115.0	146.3	161.9	170.0
SUMMER	25.0	91.0	135.0	155.0	165.9
FALL	20.0	85.0	115.0	140.0	156.3
ANNUAL	25.0	100.0	130.0	151.1	165.0

TABLE 44. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Wind Direction (Degrees) Between 1000mb (Near Surface) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	50.0	122.5	150.0	160.[illegible]	170.0
FEBRUARY	65.0	140.0	150.0	162.1	170.0
MARCH	50.0	135.0	170.0	176.5	180.
APRIL	50.0	142.5	162.5	170.0	175.0
MAY	45.0	151.0	165.0	170.0	175.6
JUNE	45.0	152.0	170.0	175.8	180.0
JULY	30.0	120.0	147.3	166.[illegible]	170.0
AUGUST	42.5	120.0	151.3	161.9	165.0
SEPTEMBER	40.0	142.5	155.0	161.9	166.8
OCTOBER	45.0	127.5	150.0	166.9	176.8
NOVEMBER	35.0	111.5	127.3	160.0	171.7
DECEMBER	45.0	115.0	147.3	171.1	175.6
WINTER	50.0	135.0	150.0	170.0	175.0
SPRING	50.0	145.0	165.0	171.9	180.0
SUMMER	40.0	140.0	155.5	170.0	180.0
FALL	40.0	125.0	151.8	165.0	170.0
ANNUAL	45.0	135.0	155.0	170.0	175.0

TABLE 45. 50, 90, 95, 97.5, and 99th Percentile Values of the Differences in Wind Direction (Degrees) Between Surface and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	50.0	137.5	165.0	170.0	170.0
FEBRUARY	70.0	135.0	145.0	172.4	180.0
MARCH	50.0	140.0	170.0	176.5	180.0
APRIL	50.0	140.0	166.3	175.0	175.8
MAY	50.0	155.0	165.0	166.0	175.6
JUNE	60.0	157.0	170.0	175.0	175.0
JULY	35.0	123.5	145.0	166.4	170.0
AUGUST	45.0	125.0	150.0	158.3	165.0
SEPTEMBER	40.0	140.0	155.3	165.0	171.8
OCTOBER	40.0	130.0	146.3	170.0	180.0
NOVEMBER	40.0	116.5	132.3	150.0	160.0
DECEMBER	50.0	120.0	161.8	175.0	175.6
WINTER	50.0	135.0	157.5	170.6	175.8
SPRING	50.0	150.0	165.0	175.0	180.0
SUMMER	45.0	140.0	160.5	170.0	170.9
FALL	40.0	130.0	150.0	160.0	170.0
ANNUAL	45.0	140.0	160.0	170.0	175.0

TABLE 46. 50, 90, 95, 97.5, and 99th Percentile Values of the Windshear (knots) Between Surface and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	20.8	31.4	34.2	44.2	46.1
FEBRUARY	13.9	27.6	29.4	31.5	40.6
MARCH	13.0	26.3	31.8	37.8	46.8
APRIL	10.2	18.3	21.7	23.9	29.6
MAY	9.1	16.9	18.4	20.0	23.1
JUNE	9.7	18.2	20.7	24.0	27.0
JULY	9.5	18.7	22.5	24.0	24.2
AUGUST	11.0	17.6	19.8	23.5	25.5
SEPTEMBER	12.0	24.5	28.4	32.3	36.9
OCTOBER	13.4	25.5	29.1	38.5	42.7
NOVEMBER	19.1	28.5	31.6	35.5	38.3
DECEMBER	21.2	33.9	43.6	46.1	47.3
WINTER	16.6	30.0	37.9	43.2	47.3
SPRING	10.7	19.8	25.9	30.0	38.0
SUMMER	10.0	18.1	21.8	23.7	25.8
FALL	14.0	27.2	30.5	35.0	40.0
ANNUAL	12.8	26.2	29.6	34.8	42.3

TABLE 47. 50, 90, 95, 97.5, and 99th Percentile Values of the Windshear (knots) Between 1000mb (Near Surface) and 850mb (1500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	19.7	29.4	35.0	44.0	46.1
FEBRUARY	11.8	25.8	28.3	31.4	40.6
MARCH	11.9	24.0	30.2	37.4	48.6
APRIL	9.0	17.9	21.3	24.1	27.8
MAY	8.3	15.5	18.0	18.7	21.3
JUNE	8.2	16.7	19.1	22.1	26.2
JULY	8.3	17.7	20.8	24.0	24.2
AUGUST	9.2	16.0	18.9	20.3	23.6
SEPTEMBER	11.0	23.3	27.3	31.7	36.3
OCTOBER	12.1	24.0	28.5	35.4	40.7
NOVEMBER	17.7	27.6	30.4	33.2	37.4
DECEMBER	19.6	31.4	43.5	44.3	46.0
WINTER	15.6	28.5	34.8	43.1	46.4
SPRING	9.7	18.4	23.7	27.3	37.6
SUMMER	9.0	16.4	19.4	21.4	24.0
FALL	12.5	25.4	29.2	33.1	37.4
ANNUAL	11.2	24.6	28.0	32.8	40.7

TABLE 48. 50, 90, 95, 97.5, and 99th Percentile Values of the Windshear (knots) Between Surface and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	24.1	41.2	44.7	56.4	59.9
FEBRUARY	15.8	31.4	36.6	35.9	40.6
MARCH	18.9	31.6	39.7	42.0	48.0
APRIL	15.0	27.2	30.1	31.9	39.9
MAY	12.7	23.4	25.6	27.4	32.1
JUNE	12.7	25.9	29.8	32.1	33.9
JULY	13.1	24.4	29.4	31.5	34.4
AUGUST	13.8	23.2	27.4	28.7	32.1
SEPTEMBER	16.4	33.9	37.9	42.9	46.0
OCTOBER	17.9	31.1	37.5	44.9	45.7
NOVEMBER	21.2	37.4	40.2	42.5	48.9
DECEMBER	21.7	36.5	48.0	50.9	51.3
WINTER	20.5	36.9	42.4	50.1	54.6
SPRING	15.3	27.9	31.2	38.4	42.9
SUMMER	13.1	25.1	28.8	31.5	34.8
FALL	17.9	34.5	39.4	42.7	46.4
ANNUAL	16.4	32.1	37.3	41.3	45.1

TABLE 49. 50, 90, 95, 97.5, and 99th Percentile Values of the Windshear (knots) Between 1000mb (Near Surface) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	23.4	39.2	42.9	56.4	59.9
FEBRUARY	16.1	30.7	33.3	36.3	39.6
MARCH	17.9	31.1	37.7	40.5	43.1
APRIL	14.3	27.2	29.1	31.9	39.2
MAY	12.9	23.2	26.0	26.8	31.8
JUNE	12.0	25.1	29.4	31.3	33.1
JULY	12.0	23.3	28.4	31.3	32.0
AUGUST	13.1	22.3	25.5	26.9	27.3
SEPTEMBER	15.6	33.3	37.2	41.1	46.3
OCTOBER	17.1	30.4	36.5	40.6	46.4
NOVEMBER	19.8	35.6	39.6	42.2	48.5
DECEMBER	19.4	35.5	46.1	50.2	51.0
WINTER	19.5	36.1	42.3	50.1	53.8
SPRING	15.0	27.4	31.0	37.0	41.5
SUMMER	12.4	23.2	27.1	31.0	32.2
FALL	17.3	33.6	33.6	40.3	46.0
ANNUAL	15.2	30.9	36.3	40.0	47.3

TABLE 50. 50, 90, 95, 97.5, and 99th Percentile Values of the Windshear (knots) Between 850mb (1500M) and 700mb (3000M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	8.8	19.3	22.1	27.5	27.6
FEBRUARY	8.5	15.2	17.6	21.5	24.0
MARCH	8.9	18.3	20.6	22.1	28.2
APRIL	7.7	14.6	17.1	17.9	20.3
MAY	7.3	14.3	16.9	21.1	24.5
JUNE	6.2	11.6	14.7	16.1	16.3
JULY	6.2	12.3	15.5	17.5	18.9
AUGUST	6.5	13.0	16.0	17.1	18.0
SEPTEMBER	8.0	16.3	18.4	22.7	25.7
OCTOBER	7.5	16.1	18.9	22.3	25.1
NOVEMBER	7.6	14.8	18.9	20.3	22.4
DECEMBER	7.3	14.5	18.0	20.6	23.7
WINTER	8.1	17.2	20.2	24.1	27.5
SPRING	8.0	16.3	18.5	21.0	25.6
SUMMER	6.3	12.5	15.9	16.6	18.2
FALL	7.7	16.0	19.1	22.2	23.6
ANNUAL	7.5	15.7	18.5	21.6	24.9

TABLE 51. 50, 90, 95, 97.5, and 99th Percentile Values of the Windshear (knots) Between 700mb (3000M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	13.4	25.5	29.2	33.3	34.7
FEBRUARY	11.7	24.8	34.4	37.7	49.1
MARCH	12.3	23.0	29.9	39.3	42.4
APRIL	11.2	29.4	34.6	41.5	46.4
MAY	10.0	21.2	27.5	30.5	33.3
JUNE	7.2	14.0	20.6	23.3	23.9
JULY	7.7	15.7	17.3	22.0	23.0
AUGUST	8.4	15.6	17.3	17.8	23.4
SEPTEMBER	10.2	21.7	30.7	41.0	51.1
OCTOBER	10.7	23.1	30.8	34.5	39.4
NOVEMBER	11.8	23.5	28.1	29.7	37.8
DECEMBER	12.5	22.4	29.1	29.9	30.3
WINTER	12.4	24.6	29.2	34.5	37.3
SPRING	11.2	24.4	31.7	36.5	44.4
SUMMER	7.7	15.6	17.7	21.6	23.9
FALL	10.7	22.9	29.9	34.3	40.2
ANNUAL	10.5	22.5	29.4	33.7	40.0

TABLE 52. 50, 90, 95, 97.5, and 99th Percentile Values of the Windshear (knots) Between 850mb (1500M) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	20.8	39.2	46.7	50.0	53.5
FEBRUARY	18.4	37.8	41.1	54.2	58.9
MARCH	21.3	33.5	43.3	44.5	51.7
APRIL	18.6	39.3	50.6	53.9	57.1
MAY	14.9	34.0	40.8	44.3	46.8
JUNE	11.2	21.9	30.0	31.3	35.9
JULY	13.2	25.5	27.3	31.2	33.0
AUGUST	12.5	25.4	29.2	33.4	36.6
SEPTEMBER	17.5	35.2	41.0	43.7	56.7
OCTOBER	16.6	36.1	42.7	47.2	53.2
NOVEMBER	18.8	35.4	40.9	42.6	47.2
DECEMBER	18.3	32.3	38.5	40.1	47.8
WINTER	19.0	34.1	44.1	46.1	57.0
SPRING	18.3	36.2	43.4	50.8	55.7
SUMMER	12.7	25.6	29.0	33.0	37.0
FALL	17.5	35.5	41.8	47.3	52.4
ANNUAL	16.6	35.1	40.9	45.6	52.3

TABLE 53. 50, 90, 95, 97.5, and 99th Percentile Values of the Windshear (knots) Between 1000mb (Near Surface) and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	31.9	57.0	59.6	76.8	77.7
FEBRUARY	25.9	47.6	55.3	56.7	57.7
MARCH	29.8	49.1	55.0	59.0	65.5
APRIL	24.8	47.8	53.2	61.3	73.0
MAY	18.7	38.3	44.7	47.3	54.7
JUNE	15.6	36.4	40.4	47.4	48.4
JULY	17.8	32.6	38.4	44.8	49.2
AUGUST	18.8	35.8	38.1	42.4	44.9
SEPTEMBER	22.7	49.3	55.3	59.4	59.9
OCTOBER	23.6	50.6	59.7	65.3	70.3
NOVEMBER	30.0	56.7	61.5	64.9	68.0
DECEMBER	32.0	47.3	50.3	72.3	74.2
WINTER	30.5	52.2	57.3	67.0	76.3
SPRING	24.0	46.0	52.1	59.1	71.0
SUMMER	17.7	36.0	39.5	46.0	49.3
FALL	26.1	52.0	59.1	63.9	67.0
ANNUAL	24.3	47.2	55.2	60.0	68.7

TABLE 54. 50, 90, 95, 97.5, and 99th Percentile Values of the Windshear (knots) Between Surface and 500mb (5500M) at Berlin, 1200 Hours GMT (1974-78, 1981).

	50TH PERC	90TH PERC	95TH PERC	97.5 PERC	99TH PERC
JANUARY	32.4	55.5	59.2	75.4	77.7
FEBRUARY	26.3	45.6	53.2	55.3	58.4
MARCH	28.5	47.0	54.6	56.9	59.5
APRIL	24.3	47.5	53.2	62.5	71.9
MAY	19.1	39.0	44.3	47.2	54.7
JUNE	16.0	36.3	44.6	46.3	47.6
JULY	17.9	31.0	37.7	44.2	46.3
AUGUST	16.1	34.4	39.2	41.5	45.5
SEPTEMBER	23.2	43.7	53.2	54.9	60.0
OCTOBER	23.0	48.9	57.3	63.9	67.8
NOVEMBER	28.9	53.5	59.2	62.9	66.2
DECEMBER	30.2	45.4	65.5	70.9	71.6
WINTER	30.2	51.2	57.2	67.3	74.3
SPRING	23.2	45.6	50.8	57.7	70.0
SUMMER	17.5	34.7	40.1	45.5	46.9
FALL	25.4	51.4	57.7	61.2	64.9
ANNUAL	24.0	46.3	52.7	59.7	67.7

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